CLAIMS

1) A high efficient recovery process for the treatment of multi-element wastes which comprises the steps of:

a) heat treatment of the waste in the presence of a controlled amount of oxygen;

b) halogenation of the product of step "a"; and

c) separation of the metal halide products of step "b".

2) A process according to claim 1 in which said multi-element waste is unsorted.

3) A process according to claim 1 in which the waste to be recovered is such that has been mechanically prepared in a process which includes any one or more of the steps of shredding, crushing, milling and briquetting.

4) A process according to claim 1 in which said primary heat treatment further comprises mechanically agitating the waste during said treatment.

5) A process according to claim 1 in which the primary heat treatment is carried out in such a way that any one or more of the actions selected from the group which consists of evaporation of water and/or organic material,

carbonization, destruction and/or cracking of organic material, and reduction of metal oxides to metals and/or metal carbides, are achieved.

6) A process according to claim 1 in which the primary heat treatment is carried out under atmospheric pressure or higher pressure, optionally in the presence of gases, preferably hydrogen, capable of cracking the organic or inorganic material.

7) A process according to claim 1 in which the halogenation reaction therein is selected from the group which consists of chlorination, bromination, or chlorination and bromination.

8) A process according to claim 1 in which at least a portion of the heat energy afforded in the primary heat treatment is used in the halogenation reaction.

9) A process according to claim 1 in which at least a portion of the product of the primary heat treatment is used as a catalyst in the halogenation reaction.

10) A process according to claim 9 in which said products to be used as catalysts are selected from the group which consists of carbon, bromine, carbon, CO, CO_2 and SO_x and NO_x compounds.

11) A process according to claim 1 wherein the primary heat treatment is performed in an oven.

12) A process according to claim 11 wherein said oven is at a temperature of less than about 1000°C.

13) A process according to claim 1 wherein the primary heat treatment is performed in a metallic molten bath.

14) A process according to claim 13 wherein said molten bath is at a temperature of between 500°C and 1600°C.

15) A process according to claim 1 which further comprises a secondary heat treatment comprising heating the gaseous flow which results from the primary heat treatment to a temperature of more than 1200°C.

16) A process according to claim 1 in which said halogenation step further comprises mechanically agitating the waste during said step.

17) A process according to claim 1 in which the halogenation reaction is performed at a temperature of between ambient temperature and 1500°C.

18) A process according to claim 1 in which the halogenation reaction is performed at a temperature of between 300°C and 1500°C, and preferably between 700°C and 750°C.

19) A process according to claim 1 in which the waste comprises a substantial percentage of any of the metals selected from the group which consists of Ag, Pt and Pd, and the halogenation reaction is performed by using a mixture of bromine and chlorine.

20) A process according to claim 19 in which said mixture of chlorine and bromine comprises between 98% and 99% chlorine and the remainder is bromine.

21) A process according to claim 1 in which at least a portion of the excess halogen gas remaining from the halogenation reaction is recycled back to the halogenation chamber.

22) A process according to claim 1 in which the separation of the metal halides is by means of any one or more of the group selected of gaseous or liquid fractional deposition, distillation, fractional distillation, filtration, selective chemical vapor deposition, settling, selective oxidation, selective halogenation, selective evaporation, selective dissolution and selective extraction.

23) An apparatus for a high efficient recovery process for the treatment of multi-element wastes, which comprises a primary heat treatment chamber, a halogenation chamber and a separation unit; said primary heat treatment chamber comprises a waste inlet, a flue-gas outlet and means of heating; said halogenation chamber comprises a means of heating, a halogen compound inlet and an outlet.

24) An apparatus according to claim 23 in which the flue-gas outlet of said primary heat treatment chamber is connected to said halogenation chamber by means of a conduit, which comprises a valve.

25) An apparatus according to claim 23 in which said separation system comprises one or more of the units selected from the group which consists of fractional deposition unit, distiller, filter, settler, selective chemical vapor deposition unit, selective oxidation chamber, selective halogenation chamber, evaporation chamber and selective dissolution unit or any combination thereof.

26) A apparatus according to claim 25, wherein the separation system comprises fractional deposition unit or selective chemical vapor deposition unit.

27) An apparatus according to claim 25 in which said separating unit is in contact with the outlet of said halogenator by means of a conduit.

28) An apparatus according to claim 23 in which said separation system is a gaseous fractional deposition system; the inlet of which is connected to the outlet of said halogenator, by means of a conduit.

29) An apparatus according to claim 28 in which the outlet pipe comprised in the fractional deposition system is connected directly to the halogenation chamber, and said pipe comprises a one-way valve in the direction from the fractional deposition system to the halogenation chamber.

30) An apparatus according to claim 23 which further comprises an additional heat chamber and a heat exchanger; said additional heat chamber comprising a means of heating, a gas inlet, an air inlet, and a flue gas outlet; said gas inlet of said additional heat chamber being connected by means of a conduit to the flue gas outlet of said primary heat chamber; said heat exchanger comprising an inlet and an outlet; the flue gas outlet of said additional heat chamber being connected by means of a conduit to the inlet of said heat exchanger.

31) An apparatus according to claim 30 which further comprises a scrubber, a filter, a blower and a stack; said scrubber comprising an inlet and an

outlet; the outlet of said heat exchanger being connected, by means of a conduit to the inlet of said scrubber; said filter comprising an inlet and an outlet; the outlet of said scrubber being connected, by means of a conduit to the inlet of said filter; said blower comprising an inlet and an outlet; the outlet of said filter being connected, by means of a conduit to the inlet of said blower; said stack comprising an inlet and an outlet; the outlet of said blower being connected, by means of a conduit to the inlet of said stack.

32) An apparatus according to claim 31, wherein the scrubber and the filter are connected to the halogenation chamber by means of conduits, to recycle material recovered and collected by said scrubber and filter to said halogenation chamber.

33) An apparatus according to claim 31 in which said filter is selected from the group which consists of fabric filter, electrostatic filter, and high temperature filter.

34) An apparatus according to claim 25 which further comprises any one or more of the units selected from the group which consists of shredder, crusher, mill, briquetter doser, and sludge feeder, which are connected to the primary heat treatment chamber; providing that the outlet of the unit connected to the primary heat treatment chamber is connected to the inlet of said primary heat treatment chamber by means of a conduit; further

providing that in the event that said apparatus comprises two or more of the above units, said units are connected succeedingly, in any combination and/or order, and are connected so by means of conduits.

35) An apparatus according to claim 23 which further comprises any one or more of the units selected from the group which consists of shredder, crusher, mill, briquetter, doser and sludge feeder which are connected between the primary heat treatment chamber and the halogenation chamber; providing that the outlet of the unit which is connected to the halogenation chamber is connected to the inlet of said halogenation chamber by means of a conduit; further providing that the outlet of the primary heat treatment chamber is connected to the inlet of the unit which is connected to said primary heat treatment chamber by means of a conduit; further providing that in the event that said apparatus comprises two or more of the above units, said units are connected succeedingly, in any combination and/or order, and are connected so by means of conduits.

36) An apparatus according to claim 23 in which said primary heat treatment chamber further comprises a means of agitating material.

37) An apparatus according to claim 36 in which said means of agitating is a means selected from the group which consists of fixed fluidized bed vibrating grid, walking grid and rotary kiln.

38) An apparatus according to claim 23, wherein the primary heat treatment chamber comprises a pressurized vessel.

39) An apparatus according to claim 23 in which said halogenation chamber further comprises a means of agitating material.

40) An apparatus according to claim 39, in which said means of agitating is a means selected from the group which consists of fixed fluidized bed vibrating grid, walking grid and rotary kiln.

41) An apparatus according to claim 23, wherein the halogenation chamber comprises a pressurized vessel.

42) An apparatus according to claim 23, in which the primary heat treatment chamber is placed horizontally, vertically or at any other advantageous angle.

43) An apparatus according to claim 23 in which the halogenation chamber is placed horizontally, vertically or at any other advantageous angle.